



**National Institute of Technology Calicut**  
**NITC Campus P.O, Kozhikode – 673601, Kerala, India**  
(Advertisement No.: P1/456/FR/2022 dated 04/10/2022)

**Syllabus for Written Test for the post of Assistant Professor Grade II (Pay Level -10)**

**DEPARTMENT OF MATHEMATICS**

There will be 50 Multiple Choice Questions and the duration of the test is 100 minutes.

**Unit 1**

Elementary set theory, Real number system, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Fatou's lemma, monotone convergence theorem, dominated convergence theorem. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems.

**Unit 2**

Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions. Banach spaces, Hahn-Banach theorem, open mapping and closed graph theorems, principle of uniform boundedness; Inner-product spaces, Hilbert spaces, orthonormal bases, projection theorem, Riesz representation theorem, spectral theorem for compact self-adjoint operators.

**Unit 3**

Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.

**Unit 4**

Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula. Taylor series, Laurent series, calculus of residues. Conformal mappings.

## **Unit 5**

Permutations, combinations. Fundamental theorem of arithmetic, divisibility in  $\mathbb{Z}$ , congruences, Chinese Remainder Theorem, Euler's  $\phi$ -function.

## **Unit 6**

Groups, subgroups, normal subgroups, quotient groups, cyclic groups, permutation groups, Cayley's theorem. Rings, ideals, quotient rings, unique factorization domain, Polynomial rings. Fields, finite fields. Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

## **Unit 7**

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. Homogeneous and non-homogeneous linear ODEs, variation of parameters.

## **Unit 8**

Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences and interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

## **Unit 9**

Probability, independent events, Bayes theorem. Random variables and distribution functions. Binomial, Poisson and Geometric distributions. Normal, Gamma, Exponential and Uniform distributions. Expectation and moments. Independent random variables, marginal and conditional distributions. Probability inequalities. Modes of convergence of random variables, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case).

## **Unit 10**

Sampling distributions, standard errors and asymptotic distributions. Methods of estimation, properties of estimators, confidence intervals and tests of hypotheses concerning mean, variance and proportions, Chi-square test of goodness of fit.